ENCLOSURE 2

Shootering Canyon Tailings Retention System
Plateau Resources Limited
Docket No. 40-8698 (TAC No. 5063)
Safety Evaluation Input - Geotechnical Engineering Section, GB, DSS
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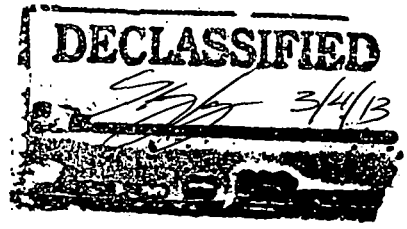

Introduction

The proposed uranium tailings retention system is to be constructed at the Shootering Canyon site in Garfield County, located in southeastern Utah. The impoundment area will be 14 miles from the nearest existing permanently occupied area (Bullfrog Basin Marina). The tailings impoundment will be located in a valley which slopes gently downward to the south. A high steep butte lies immediately west of the valley and several low-lying mesas lie to the east. The ground surface elevations range from approximately 4576 at the north end of the mesa where the plant will be built, to about 4350 in the proposed tailings pond.

The design of the impoundment was based on a requirement to store 20 years of tailings output from the plant at 750 tons per day. Design of the embankment was based on construction in 2 stages - to an initial crest at Elevation 4433 and a final crest at Elevation 4466. The 1400 feet long zoned embankment will have an impervious, sloping core, transition zones, shells constructed of local pediments, and a downstream blanket drain. A clay liner will be provided in the impoundment area. The tailings management plan anticipates initial deposition at the upstream end of the impoundment.

Subsurface Investigations

A total of twenty exploratory borings ranging in depth from 16.5 to 152.5 feet below the existing ground surface were drilled at the site. Soil samples were obtained with a 2-inch outside diameter split spoon sampler and a 2-inch inside diameter modified California drive sampler lined with thin, brass segmented tubes. Rock core was obtained using an NX double-tube core barrel

with diamond bit. Twenty-eight shallow test pits were excavated for the purpose of exploring the potential borrow areas, the foundation for the proposed tailings dam and the plant site. Water pressure testing with packers was done in a number of borings in order to evaluate the in-situ permeability of the geological formation.

Laboratory Testing

Representative samples were selected for laboratory testing in order to establish engineering properties of the embankment and foundation materials. Laboratory testing included water content, dry density, Atterberg limits, grain size, compaction, unconfined compression, triaxial shear and permeability tests. We conclude that the laboratory testing was adequate and that the applicant has properly established foundation and embankment material properties required for design.

Foundation Conditions

Exploratory borings in the foundation materials for the portion of the dam across the main valley showed a thin surface layer of loose fine sand, a maximum of 2 feet in thickness. Soft to medium hard and occasionally moderately hard, fine-grained sandstone with occasional thin zones of silty, clayey fine sandstone was encountered beneath the sand and extended throughout the depth of the borings (152.5 feet). Borings drilled in the saddle area of the embankment, to be used as an emergency spillway, encountered shallow alluvial deposits consisting of about 12 feet of dense fine sand with some gravel overlying dense cobbles, gravel and sand to a depth of from 23 to 29.5 feet. Soft to medium hard fine-grained sandstone underlies the alluvial deposits.

From available information, the depth to groundwater is in excess of 100 feet in the area of the proposed tailings impoundment. The field exploration program did not indicate any apparent impervious boundaries at depth. Permeability coefficients of the sandstone foundation obtained from the in-situ permeability tests ranged from 1×10^{-6} cm/sec to 1×10^{-5} cm/sec.

Embankment Foundation Preparation

The embankment across the valley and the saddle section was aligned to take advantage of the naturally occurring abutments and to minimize foundation excavation. Loose soil remaining after topsoil has been stripped from dam and reservoir areas will be removed and stockpiled for possible later use as fill. All soil will be excavated to sound bedrock in the core (Zone 1) foundation and the exposed bedrock will be slush grouted. Irregular bedrock surfaces will be removed to obtain a generally smooth surface. All soil will not necessarily be removed beneath the transition zones and shells. The suitable foundation soil remaining after excavation will be scarified and recompacted. Upon completion of foundation preparation, the bedrock and soil foundation conditions will be documented as detailed in the attached license conditions.

Embankment Design

a. Cross-section - The zoned embankment to contain the tailings will be constructed in two stages. The stage 1 crest will be at Elevation 4433 (crest width of 85 feet). The maximum height of the stage 1 dam is 85 feet and the maximum height of the stage 2 dam is 118 feet. Upstream and downstream embankment slopes will be 2 horizontal on 1 vertical. Internal zoning will consist of an impermeable sloping core (Zone 1), shells constructed from local pediments (Zone 2) and upstream and downstream sand transition zones

between the core and shells (Zone 3). A 24 inch thick gravel blanket drain and 6 inch thick blanket filters will be provided under the downstream shell and tied into a toe drain. The crest of each stage is to be covered with 2 feet of roadbed material.

b. Upstream Liner - An upstream liner has been designed to inhibit seepage of the effluent into the foundation rock and the concomitant contamination of the groundwater and surrounding areas. The liner will consist of impermeable clay constructed of Zone 1 material and tied into the core. The liner will be covered by a granular sub-drain and a layer of waste rock. The thickness of the compacted clay is to be 10 percent of the applied hydraulic head with a minimum thickness of 2 feet. The sub-drain will be a fine sand meeting the criteria for Zone 3 and will have a minimum thickness of 18 inches. The protective waste rock layer will have a minimum thickness of 12 inches.

c. Materials - The fill for the impoundment clay liner and the impervious core will consist of sandy silty, clayey soil obtained by breaking down natural sandy, clayey shales of the local Brushy Basin, Mancos or Summerville formations. No material larger than one inch in size will be permitted in the clay liner or the impervious core and the percentage of fines (finer than the No. 200 mesh sieve) will be greater than or equal to 50 percent. Other specification controls require a minimum density of 95 percent of maximum dry density established in the standard Proctor compaction test (ASTM D698-70), placement at moisture as detailed in the license conditions, and a maximum loose lift thickness of 8 inches.

The shell sections (Zone 2) will be constructed from the pediment boulders, cobbles, gravel and sand which cap the mesa tops. The maximum size of the Zone 2 material will be 12 inches and material larger than 12 inches in size will be raked to the outer portion of the zone to serve as slope protection material. A test fill for Zone 2 material will be constructed prior to commencement of fill placement to establish the compaction characteristics of this material and to verify the adequacy of the present "method" specification of 4 passes on each layer with a 10-ton vibratory roller. Layers of Zone 2 materials will not exceed 12 inches in loose thickness except in the outer 10 feet of shell (slope protection) where a maximum of 18 inch lifts may be used. The material in this zone will be uniformly wetted prior to compaction. In order to meet filter criteria between Zones 2 and 3, the finer fraction of Zone 2 material will be placed adjacent to Zone 3. This will be accomplished during Zone 2 construction by continuously raking the material larger than 4 inches out of the area adjacent to Zone 3. The transition zone (Zone 3) between the core and the shells will be constructed of fine sand available in local dune sand deposits. The Zone 3 materials meet filter criteria and thus will act as a filter to protect against piping of the Zone 1 material into Zone 2. The Zone 3 fine sand will be compacted to either (1) an average of 85% but not less than 80% relative density as determined by ASTM D-2049, or (2) at least 95% of the maximum dry density as determined by ASTM D-698-70, whichever results in the higher in place dry density. Other specification controls of the fine sand include gradation limits, placement at moisture contents as detailed in the license conditions and a maximum loose lift thickness of 8 inches.

The blanket drain and filter will be constructed of processed material meeting specified gradation requirements. Granular material in these zones will be uniformly wetted then compacted by 4 passes of 20 ton vibratory equipment.

The proposed specification controls on material type, placement and compaction for the proposed dam are consistent with methods used today in embankment construction, and are considered to be acceptable.

d. Stability Analysis

The proposed stage 2 dam configuration was analyzed for stability of the upstream and downstream faces along its maximum cross-section. The Morgenstern-Price method was used for analysis of non-circular failure surfaces under loading conditions that are consistent with the guidelines of Regulatory Guide 3.11. Analysis for seismic conditions consisted of pseudostatic analysis; additional forces due to .08g in the horizontal direction and .04g in the vertical direction were applied to account for loading under earthquake conditions. The applied seismic forces are considered conservative based on Algermissen and Perkins, 1976 (Ref. 5). It should be noted however, that GSB has not made a detailed geology-seismology review of this site.

Results of stability analyses equaled or exceeded the minimum safety requirements of Regulatory Guide 3.11 for all loading conditions.

e. Seepage Control - The contouring of the impoundment will be such that the upstream sub-drain can carry the effluent to a collection pipe system which ultimately discharges into a sump to be recycled back to the processing plant or the impoundment. Construction of the liner against the steep slopes along the western margin of the impoundment will be accomplished by trimming the slopes to allow for conventional placement of the clay blanket or, wehre this is not practical, by placing the blanket in stages as a buttress to the same elevation as the rising tailings elevation. Although the entire impoundment is to be prepared for the ultimate construction of the liner, the liner will be constructed at this time only to the stage 1 limits of tailings disposal (upstream end of impoundment area).

A series of groundwater monitoring wells have been placed around the outside perimeter of the embankment and impoundment to monitor any seepage through the liner. In addition, any seepage through the embankment will be collected by the downstream toe drain and recycled to the plant.

f. Liquefaction Potential

A liquefaction analysis was not performed. The granular materials of Zones 2 and 3 in the embankment are to be densified under strict specification requriements which should ensure their stability against liquefaction. The alluvial deposits found beneath the saddle portion of the embankment exhibit "N" values in the standard penetration test sufficiently high that further consideration of liquefaction potential is not considered to be necessary.

g. Instrumentation

The installation of piezometers and surface displacement monuments is not considered necessary for the stage 1 embankment since it will not be subjected to the hydraulic pressures and external forces from the tailings effluent. Instrumentation of the embankment will be required at stage 2 or in the event that tailings management plans change and tailings effluent is placed against the Stage 1 embankment (see license condition 2).

Construction

The applicant has provided plans and specifications (Reference 3). The results of construction inspection and control testing by the applicant are to be summarized in a concise construction report. This report must be submitted to the NRC not later than six months following completion of construction in order to show that the impoundment has been constructed as designed. Recommended minimum inspection of the construction by the NRC has been provided in license condition 1.

Conclusion

Based on the review of the submitted documents, we conclude that the proposed Shootering Canyon tailings retention system meets the intent of Regulatory Guide 3.11 and will result in a safe system providing the recommended licensing conditions attached to this report are carried out.

References

1. "Tailings Management Plan and Geotechnical Engineering Studies, Shootering Canyon Uranium Project," Woodward-Clyde consultants, September, 1978.

2. Letter from M. B. Bennedsen, Senior Project Engineer, Woodward-Clyde Consultants to Mr. Ross A. Scarano, NRC, January 19, 1979.

3. "Stage I - Tailings Impoundment and Dam Final Design Report Shootering Canyon Uranium Project," Woodward-Clyde Consultants, May 1, 1979.
   Supplemental Data; June 12, 1979.

4. Letter from R. B. Sewell, Manager of Operations, Plateau Resources Limited to Mr. Pete Garcia, NRC, July 31, 1979.

5. Algermissen, S. T. and Perkins, D. M., 1976 "A Probabilistic Estimate of Maximum Acceleration in Rock in the Contiguous United States," U. S. Geological Survey, Open File Report 76-416.

Recommended License Conditions

1. Provide commitment to notify the NRC at least three weeks prior to construction of the following features in order to provide adequate time for arrangements of on-site inspections by the NRC.
   a. Near completion of foundation preparation but prior to placement of backfill in the trench or over excavated surfaces.
   b. During early stage of embankment fill placement.
   c. At approximately 75 percent completion of embankment fill placement.
2. Provide commitment to submit a detailed embankment instrumentation program for NRC review one (1) month prior to either construction of stage 2 of the embankment or to implementation of any plans for placing tailings effluent against the stage 1 embankment.
3. Density of Zones 1 and 3 shall be controlled in the field in accordance with ASTM D-1556, D-2167 or by approved nuclear devices in accordance with ASTM D-2922 and D-3017. One test shall be made for each 2,000 cubic yards or less for each layer. Moisture density tests (ASTM D-698 or D-2049) Atterberg limits (Zone 1), and gradation tests shall be performed at the frequency of one test for each 30,000 cubic yards of fill placed. Field density tests will be made in Zone 2 at the frequency of one test for each 50,000 cubic yards in order to verify that the degree of compaction demonstrated in the test fill is being maintained. The results of all quality control tests shall be submitted to the NRC within six months of completion of construction.

4. A report documenting the embankment foundation conditions shall be submitted to the NRC within six months of completion of the foundation preparation. The report shall include but not be limited to the following:

   a. Plan views of the foundation area showing material-types, locations of any anomalies or potential seepage paths, and the extent of slush grouting.

   b. Photos taken during foundation preparation

   c. Description of procedures used to proof test the foundation soil.

5. All fill placed in Zones 1 and 3 shall have moisture contents meetings the following limits:

   a. Zone 1: optimum moisture content to 3 percent wet of optimum.

   b. Zone 3: 1 percent dry density of optimum to 1 percent wet of optimum.

ENCLOSURE 3

TYPICAL TECHNICAL ASSISTANCE REVIEW SCHEDULE

Request for Technical Assistance Received (with Environmental Report)	---
Site Visit*	4-7 weeks
Request for Additional Information	8-10 weeks
Response Received**	12 weeks
Assessment Transmitted***	26 weeks

* In order to schedule the site visits as early on in the review process as possible, it would be useful to have advance notice concerning specific technical assistance requests so as to allow us lead time in making contractual arrangements as required.

** Clearly, response to requests for additional information is the most critical factor in this schedule. All target dates are based on the assumption that the applicant's proposal is basically acceptable at the time of submission or else adjustments are made very quickly.

*** During the period between week 12 and week 26, the staff could provide a draft to the State and allow a brief (approximately 1-2 weeks) time for comments if this is needed. Any such state review prior to receipt of the final assessment would be negotiated on a case-by-case basis. This would, of course, be in addition to the closely coordinated review efforts of the NRC and State staffs which lead to the technical conclusions that are documented in the report.

ENCLOSURE 4

UNITED STATES NUCLEAR REGULATORY COMMISSION

MAY 13 1977

BRANCH POSITION - URANIUM MILL TAILINGS MANAGEMENT
Fuel Processing and Fabrication Branch

Background

A major expansion in the uranium industry is taking place. Many times more uranium will be extracted in the upcoming decades than has been extracted so far. This requires that the NRC examine very closely the past problem areas encountered in the uranium industry and make sure they are not compounded on an even larger scale.

The first major portion of the industry within the licensing jurisdiction of the NRC is uranium milling. The major problem encountered in past milling operations is the management of tailings generated by the milling process. Although the concentration of radioactivity in the tailings is relatively low, control measures are necessary because of the large quantities involved and because of the long half-life of the parent radionuclides that are present.

The management of mill tailings has received increasing attention and interest in recent years from involved federal and state agencies and from environmental conservation groups. This interest has resulted from studies carried out during the last decade which have indicated that uranium mill tailings, if not properly managed and controlled, could present a potential public health hazard. The most vivid example, of course, is the situation that occurred in Grand Junction. The remedial actions determined necessary to correct the misuse of tailings in the construction of homes, schools, and other public structures are continuing at substantial cost to the Federal Government and the State of Colorado.

In addition, final technical resolution and financial responsibility for the disposition of tailings at the 22 "inactive" sites being evaluated by ERDA will further increase public, state, and local as well as congressional concern with prevention of similar problems in the future.

It is incumbent on NRC and the uranium industry to assure that current and future licensed milling operations do not result in similar situations.

Towards this end, the NRC staff has developed performance objectives for an acceptable tailings management program based on the most up-to-date technology available today.

Position

The staff is of the opinion that an acceptable tailings management program will vary depending on site or region specific parameters, such as geology, hydrology, and meteorology. Viable methods of tailings

management for a specific mill location may include classic impoundment behind a dam, deep mine burial, open pit mine burial, specially excavated pit burial, or even elimination of radioactive waste by process variations.

Considering the many variables involved, the staff will use the following performance objectives to determine the adequacy of proposed site specific tailings management programs.

Siting and Design

1. Locate the tailings isolation area remote from people such that population exposures would be reduced to the maximum extent reasonably achievable.

2. Locate the tailings isolation area such that disruption and dispersion by natural forces is eliminated or reduced to the maximum extent reasonably achievable.

3. Design the isolation area such that seepage of toxic materials into the groundwater system would be eliminated or reduced to the maximum extent reasonably achievable.

During Operations

4. Eliminate the blowing of tailings to unrestricted areas during normal operating conditions.

Post Reclamation

5. Reduce direct gamma radiation from the impoundment area to essentially background.

6. Reduce the radon emanation rate from the impoundment area to about twice the emanation rate in the surrounding environs.

7. Eliminate the need for an ongoing monitoring and maintenance program following successful reclamation.

8. Provide surety arrangements to assure that sufficient funds are available to complete the full reclamation plan.

Implementation

All objectives will be considered and satisfied during the review of proposed tailings management programs for new milling operations.

Current licensees' tailings management programs will be reviewed to determine the best way to apply objectives 4 through 8 to the extent practicable.

During the course of license renewal reviews, the locations of existing tailings areas will be reviewed considering objectives 1 through 3 to determine if sufficient cause exists to require an alternate disposal location for tailings generated by future milling operations and the relocation of existing tailings at the time of mill decommissioning.